Endogenous dynamics of institutional change

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Abstract
A parsimonious set of mechanisms explains how and under which conditions behavioral deviations build into cascades that reshape institutional frameworks from the bottom up, even if institutional innovations initially conflict with the legally codified rules of the game. Specifically, we argue that this type of endogenous institutional change emerges from an interplay between three factors: the utility gain agents associate with decoupling from institutional equilibria, positive externalities derived from similar decoupling among one's neighbors, and accommodation by state actors. Where endogenous institutional change driven by societal action is sufficiently robust, it can induce political actors to accommodate and eventually to legitimize institutional innovations from below. We provide empirical illustrations of our theory in two disparate institutional contexts—the rise of private manufacturing in the Yangzi delta region of China since 1978, focusing on two municipalities in that region, and the diffusion of gay bars in San Francisco in the 1960s and 1970s. We validate our theory with an agent-based simulation.

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Introduction

As distinct from top-down change enacted by political actors, endogenous institutional change occurs when institutional innovations and new organizational forms emerge and diffuse through a bottom-up social dynamics. Institutional change of this type is an "emergent"—rather than planned—phenomenon. In countless empirical cases, emergence can be traced to experimentation and coordinated action among individuals and organizations (Clemens, 1993; Gould, 1995; Morrill et al., 2003; Nee and Ingram, 1998; Nee and Opper, 2012; Owen-Smith and Powell, 2006; Padgett and Powell, 2012; Powell et al., 1996; Rao, 1998; Rao et al., 2003; Rogers, 1962). "Bottom-up" institutional changes, such as the rise and diffusion of novel organizational forms, practices and industry standards, have been widely documented (Briscoe and Murphy, 2012; Carroll and Swaminathan, 2000; Holm, 1995; Tolbert and Zucker, 1983). In such cases, meso-level social structures—namely, stable and entrenched organizational fields—provide a locus of action and identity in which new organizational forms and institutional practices emerge (Ruef, 2000).

The puzzle of this type of endogenous institutional change lies in explaining how initially illegitimate organizational and institutional innovations arise in spite of legal prohibitions and accompanying sanctions. The spectrum of such change is wide, ranging from the legalization of drugs, civil rights, women's rights, abortion rights, gay rights, anti-apartheid, and dissident movements, to the development of stock trading and new organizational forms like Airbnb and Uber; cases such as these are neither readily nor adequately explained by state-centered accounts. Earlier theories highlighted collective action problems that make this puzzle especially vexing (Hardin, 1982; Olson, 1965). Why would rational actors assume the cost and risk of participation to bring about institutional change if they can instead "free ride" on the effort of others? The problem is Pareto inefficient in that free riding leads to underprovision of public goods. And knowing the unlikelihood that individual effort will be efficacious in bringing about desired changes, why would any individual take the risk of being a "first mover?"

When innovators operate beyond the boundaries of the established order, new organizational forms must co-evolve with the institutional innovations that make adoption of the new form gainful and thus self-reinforcing. Here, the focus on initially illegitimate or illegal action means we must consider the role of state actors, who can either sanction or accommodate institutional innovations that deviate from the established order. We propose a theory that specifies mechanisms of endogenous institutional change centered on agents embedded in spatially

concentrated relationships—change which in turn triggers the involvement of political actors to enact formal accommodative change. By focusing analytic attention on a micro-foundation of interacting individuals, we build upward to explain institutional change at the macro-level leading to the institutionalization of economic institutions and organizational forms (Baldassarri, 2009; Coleman, 1990; Macy and Flache, 2009).

Our point of departure is the intuitively simple observation that even widely accepted institutional arrangements endure some small amount of routine defection not compliant with the established institutional framework. Some extent of deviant and oppositional behavior is observed wherever corresponding dominant informal norms and formal rules can be found. Thus, it may be useful to characterize self-enforcing institutional frameworks as "stochastically stable" rather than as Nash equilibria (Foster and Young, 1990). The question then is which conditions allow innovations in private orders to evolve into the widespread decoupling that uproots and transforms institutional frameworks from below. We extend Nee and Opper's (2012: 23–32) model of institutional innovation in arguing that "bottom-up" institutional transformations are made possible by the utility gain actors acquire or associate with decoupling from institutional equilibria and positive externalities derived from similar decoupling among one's neighbors. Following Nee and Opper's (2012: 20) multi-level model, we also argue that these mechanisms can generate accommodation from state actors, which in turn codifies informal behavioral changes as formal institutional change.

We begin with a brief sketch of approaches to theorizing institutional change in economics and political science. We propose a sociological theory of endogenous institutional change that can account for cases that state-centered theories cannot adequately explain—that is, when initially illegal institutions emerge from collective action—and we then employ a simple agent-based computational model to examine the internal validity and theoretical plausibility of the mechanisms. The model dynamics show how actors engaged in ongoing interactions are able to overcome coordination problems in the pursuit of valuable institutional innovations. We illustrate the general contours of our argument through examples in two strikingly different contexts: the rise of private manufacturing firms in concentrated industrial districts in Wenzhou and its slower rise in Shanghai before the formal introduction of a national Private Property Law, and the diffusion of gay bars in San Francisco. Although these settings and subjects differ, the interplay of the above mechanisms—utility gain from decoupling, network externalities and strategic action by political actors—can explain the distinct pathways of endogenous institutional change in each case.

The challenge of explaining institutional change

People can be motivated by incentives to engage in collective action in pursuit of common interests. Small groups can readily act on shared interests; however, in larger groups, there must be side-incentives for individual members before they are sufficiently motivated to act in accordance with shared goals (Olson, 1965). Institutional change—including the design, implementation, and enforcement of rules—entails costs to achieve common interests that benefit all members—costs that individual actors will be unwilling to assume (Marwell and Oliver, 1993; North, 1990; Oliver, 1993). For individual members of large groups, there is a positive incentive to free ride on the contributions of others. This logic of collective action provided the foundation for state-centered perspective of institutional change focusing on strategic action of the political elite. As North (1981) reasoned,

> institutional innovation will come from rulers rather than constituents since the latter would always face the free rider problem. The ruler will, on his side, continue to innovate institutional change to adjust to changing relative prices since he has no free rider problem. (p. 12)

Historical institutionalists similarly focus on the political context to specify the type of "dominant change agent that is likely to emerge and flourish in any specific institutional context, and the kinds of strategies this agent is likely to pursue to effect change" (Mahoney and Thelen, 2010: 15). In both perspectives, whether in punctuated equilibria or gradual change, political actors initiate and guide institutional change.

In an attempt to break away from North's state-centered perspective, Greif shifts analytic attention away from the political elite to endogenous motivations—expectations, beliefs, and norms—of interacting individuals to examine how and under what specific conditions institutions influence people's behavior. At the micro-level, in this approach, economic actors strive for individual utility while recognizing that the existing institution is a self-enforcing equilibrium that shapes their transaction costs. Like North, Greif (2006) frames the problem of institutional change in terms of the "prisoner's dilemma" and thus concludes that coordination problems are too great an impediment for collective action to be the driver of institutional change—since "[institutionalized] behavior is an equilibrium, there are no endogenous forces causing institutions to change" (p. 10). Since no one individual will deviate without knowing that others will do the same, institutions are self-reinforcing in the absence of a top-down intervention.

Recognizing the empirical limitations of this formulation, Greif and Laitin (2004) modify the game-theoretic approach by linking the analytic

statics of game theory with the path-dependent cumulative causation perspective of historical institutionalists (Hall and Taylor, 1996; Pierson and Skocpol, 2002; Thelen, 1999). Through the conceptual innovation of the "quasi-parameter," Greif and Laitin argue that not all institutions are self-enforcing; some imply self-undermining behaviors that eventually lead to the institution's demise independent of an external shock shaking up the institutional equilibrium, but they still offer no systematic explanation for how institutional change can occur in a bottom-up manner through societal action.

An influential line of research from stochastic evolutionary game theory (Young, 1993, 1998, 2011, 2015) has shown that the framing of the institutional change problem is consequential. When viewed as a large-scale coordination game rather than a prisoner's dilemma, small and initially random deviations can spark cascades allowing entire populations to shift from one equilibrium to another. In these models, coordinated deviation first emerges in regions of a social space and then spreads outward, drawing neighboring regions into the new behavioral alignment.

Sociological institutionalists, for their part, have focused on the meso-level structures that help to channel such "bottom-up" change. From this perspective, collective action problems are to a large extent bypassed through the explicit incorporation of organizational fields facilitating mutual observation, signaling, communication, and diffusion of novel practices and deviating norms (Powell and DiMaggio, 1991; Scott, 2001). Closely observing and monitoring the outcomes for early adopters is often sufficient to attract followers and to organize local cooperation if institutional innovations promise a utility gain (Rogers, 1962). A broad array of analytical and empirical studies support the view that close-knit communities interacting over time through shared interests and identities may very well be able to generate informal norms—oftentimes deviating from formal rules—that are effective in governing community exchange (Baldassarri, 2009). Bottom-up social norms have been shown to effectively avoid the "tragedy of the commons" (Ostrom, 1990). They have proven to be effective in managing business risks among diamond traders (Bernstein, 1992) and form the foundation of conflict resolution among cattle farmers in Northern California (Ellickson, 1991).

Much of this research examines change in well-bounded functioning community ecologies and explores the rules of the game once the game and the landscape and the participants are known (Powell and DiMaggio, 1991; Ruef, 2000; Scott, 2001). While drawing on insights from these prior studies, our emphasis is on the evolution of a new game adopted by new participants and the diffusion processes shaping simultaneously the emerging

organizational landscape and community boundaries. We ask what factors induce bottom-up institutional innovations and allow them to diffuse. Under what conditions do local defections from the status quo trigger a social movement attracting new participants into an emerging field? Collective action arising from such conditions can generate the self-reinforcing process of endogenous institutional change that elicits accommodative state action, eventually leading to political shifts in policy and law that re-establish congruence between informal norms and formal rules.

We define institutions as relatively enduring social structures comprising interrelated informal and formal elements—beliefs, norms, rules, and organizations—governing social, political, and economic life. As self-enforcing social structures, institutions enable, motivate, and guide cooperation and competition by specifying the constraints on social action in pursuit of legitimate interests. All institutions evolve over time, but during episodes of institutional change, bottom-up and top-down processes interact to influence the emergence of the new institutional order (Alba and Nee, 2003; Dobbin, 2009; Greif, 2006; Nee and Opper, 2012; Padgett and Powell, 2012; Scott, 2001).

We focus on the interplay of three mechanisms, each of which has previously been discussed—either independently or jointly with others—as a driver or constraint of institution building and norm diffusion. (1) *Net utility*: Even institutional frameworks in stable equilibrium suffer from deviation. A probabilistic process of bottom-up experimentation, often at the margin of established institutional orders, generates intermittent institutional innovations such as a new organizational form or institutional arrangement. Those innovations deviating or in opposition to the rules of the game are more likely to be reproduced if other individuals expect sufficient utility above that of compliance. (2) *Network externalities*: Within local clusters of deviators following the same novel behavioral strategy, the rise of cooperation norms helps to realize gains from coordination, generating positive externalities that make diffusion self-reinforcing in networks, communities, and regional economies. These first two mechanisms are familiar in models of the diffusion of innovations (e.g. DiMaggio and Garip, 2011; Young, 2011). In cases of institutional shifts that challenge formal legal frameworks, however, they combine with a key third mechanism. (3) *State accommodation*: As decoupling through institutional innovation diffuses more broadly, political actors find it increasingly impractical and costly to sanction deviators; instead, they accommodate and implement *ex post* changes bestowing formal legitimacy. Hence, *The greater the utility gain and larger the network externalities, the more likely it is that political actors will accommodate endogenous institutional change*. Accommodations

by political actors may involve incremental change such as allowing institutional drift in enforcement, altering the enactment or interpretation of existing rules, or layering new rules on top of existing ones—or existing rules may be entirely removed and new ones introduced (Mahoney and Thelen, 2010).

Processes of endogenous institutional change begin with random deviation from otherwise stable institutional arrangements. An institutional framework's vulnerability to such deviation is conditioned by the relative gains from compliance and deviation. Initial deviators may be disappointed to find that the net utility of an innovation is not great enough to justify its continued pursuit. They may be unable to find enough collaborators among like-minded neighbors to make continued deviation worthwhile. Or, when a deviating behavior carries risk of sanction, potential deviators may be held in check by fear of reprisal. *If the utility gain of deviance fails to generate network externalities, then decoupling will be confined to private orders with limited scope for growth.*

In some circumstances, deviators will find the utility gain provided by an innovation to be worth the risk. Gainful deviation reproduces itself in the population, while unsuccessful deviation disappears without unsettling or undermining dominant institutional arrangements (Macy and Skvoretz, 1998). Those engaged in coordinated—rather than isolated—cooperative behavior reap greater rewards due to positive network externalities. Countless social situations have this quality: hockey players wear helmets knowing that others will do the same, drivers who benefit from driving on the right side of the road only if all other cars obey the same rule, and the contingent benefits of adjusting one's clock for daylight savings, which depend crucially on whether one's neighbors follow suit (Schelling, 1973; see DiMaggio and Garip (2011) for a more recent analysis). In endogenous dynamics of institutional change, one agent's gainful deviation attracts neighbors to follow suit. The emergence of a stable cluster of deviators further amplifies the gains of coordination and pulls even more neighbors into the fold in a self-reinforcing "tipping" dynamic (Nee and Opper, 2012: 24–32). Others who may not have been willing to take the initial step of risky experimentation will nonetheless join the local bandwagon begun by their more entrepreneurial neighbors as collective action gains self-reinforcing momentum.

In the organizational setting where boundaries establish denser networks, resource mobilization entails micro-level interaction between individual utility and network externalities driving the diffusion of self-reinforcing social movements (Diani and McAdam, 2003; McCarthy and Zald, 1977; Zald and Berger, 1978). The social movement literature provides abundant

accounts of challenges from below in organizations and markets that gain self-reinforcing social dynamic (Carroll and Swaminathan, 2000; Davis and Thompson, 1994; Rao, 1998; Rao et al., 2003; Soule, 1997). *Large utility gains interacting with network externalities increase the payoff from collective action as deviance assumes a self-reinforcing social dynamic.*

Yet, regardless of how individual incentives are structured, deviation remains unlikely to survive in the long term unless it is eventually reinforced by accommodative action from political actors. Where deviation is widespread, such political change can be a matter of practical necessity due to the costs associated with effective enforcement of laws that are ignored or willfully disobeyed by large swaths of the population. *If utility gain and network externalities give rise to self-reinforcing "tipping" dynamics, the cost of enforcement increases to prohibitive levels for state actors.*

In the face of mounting costs, unofficial adaptation and lax enforcement often precede accommodative changes to formal rules by the state. *De jure* property rights are more secure and lasting than informal rights embedded in networks and norms. Formal rule change is less subject to misinterpretation than verbal understanding of agreements or condition of exchange. If a deviating behavior produces social value or taxable revenue above and beyond that produced by compliance with current rules, the state may enact *ex post* reforms to provide legitimacy or even encourage previously outlawed behaviors. Political actors thus play a key role in processes of endogenous institutional change, albeit after—rather than before—decoupling has become self-reinforcing. It is here that this sociological theory of endogenous institutional change links up with allied social science approaches. We agree with new institutional economics and historical institutionalists that the political context is crucial in resolving the power implications of institutional change. Whether in transformative or gradual institutional change, political actors innovate and enact the formal rules necessary to accommodate and legitimize emergent institutional orders arising from below (Greif, 2006; Greif and Laitin, 2004; Mahoney and Thelen, 2010; Nee and Opper, 2012; North, 1990; Padgett and Powell, 2012; Pierson, 2004; Skocpol, 1979; Streeck, 2009).[1]

Agent-based models of endogenous change and stability

Agent-based models are especially useful when we have clear assumptions as to how individuals behave but limited understanding of the macro-level consequences of those behaviors (Macy and Willer, 2002).[2] Rather than accommodating the full complexity of real-world cases, the goal is to "explore the simplest set of behavioral assumptions required to generate a

macro pattern of explanatory interest" (Macy and Willer, 2002: 146). Here, we want to distill the dynamics theorized above to an abstracted form that nonetheless retains the essential ingredients for an account of endogenous institutional change. A secondary goal is to illustrate combinations of conditions that would prevent endogenous change, since case-based research is subject to biases stemming from the selection of successful cases.

Our model builds upon previous work on the evolution of social norms, diffusion of institutional innovations (Nee and Opper, 2012), and choices with network externalities (Axelrod, 1984, 1986; Nee and Lian, 1994; DiMaggio and Garip, 2011; Schelling, 1973; Young, 1993, 2011). Individuals are forward, backward, and sideways-looking cultural imitators whose behavior is influenced by neighbors who are doing well (Heckathorn, 1996). Accordingly, we assume that actors benefit from a behavioral strategy to the extent that neighbors pursue the same strategy. Yet, endogenous institutional change involves a key obstacle that does not appear in these models. In order for successful emergence of a new institutional innovation to occur, potential deviators must overcome not only the problem of coordination with other agents but also potential opposition from state authorities invested in the status quo.

The autonomous but interdependent agents in our artificial population make a binary decision between compliance ($D_i = 0$) and deviation ($D_i = 1$).[3] Each agent i initially complies ($D_i = 0$ for all i). When called upon, i updates its behavior as a function of the difference in utility from the two available choices. First, the gain from compliance is

$$U(C) = A\left(1 - \frac{\sum_{j=1}^{N_i} D_j}{N_i}\right) \tag{1}$$

where i's neighbors are indexed by j, N_i is the number of agents (excluding i) in i's neighborhood, D_j is neighbor j's current state (0 for compliant or 1 for deviating), and A is a multiplier that fixes the utility of compliance.[4] The utility of deviation is computed similarly, but with one crucial addition. Since deviation puts agents at risk of sanction from a state authority interested in maintaining compliance with institutionalized rules, agents only expect to realize gains from deviation insofar as they also expect to avoid this undesired outcome. Formally

$$U(D) = B\left(\frac{\sum_{j=1}^{N_i} D_j}{N_i}\right)(1 - f_i) \tag{2}$$

where B is a multiplier for the utility associated with deviation and f_i is i's estimation of the probability of sanctions (D_j and N_i are the same as in equation (1)).

Agents assess the likelihood of sanctions by looking around their neighborhood to gauge other agents' states and their outcomes. Those who see abundant evidence of sanctioned deviation are more fearful than those who do not. More formally

$$f_i = \begin{cases} \theta S_i + (1-\theta) \dfrac{\sum_{j=1}^{N_i} S_j}{\sum_{j=1}^{N_i} D_j} & \text{if } \sum_{j=1}^{N_i} D_j > 0 \\ \qquad \theta S_i & \text{otherwise} \end{cases} \tag{3}$$

where S_i is a binary indicator of whether agent i was sanctioned in the most recent round of updating (if yes, then $S_i = 1$) and θ is an exogenous parameter ($0 \leqslant \theta \leqslant 1$) that fixes the weight agents place on their own recent experiences with sanctions relative to those of neighbors. When a deviating agent and all of the deviating neighbors suffer sanctions, $f_i = 1$ and the expected utility of deviation is reduced to zero. At the opposite extreme, when an agent does not observe any sanctions (which can occur either because everyone simply complies or because all local deviators have gone unsanctioned), $f_i = 0$ and the agent expects—rightly or wrongly—to receive the full benefits of unencumbered deviation.

Agents ultimately choose compliance or deviation as a probabilistic function of the difference between $U(D)$ and $U(C)$. We use the cumulative logistic function

$$\Pr(D_i = 1) = \frac{1}{1 + e^{-\beta[U(D) - U(C)]}} \tag{4}$$

where β is a slope parameter that controls the shape of the S-curve and determines how deterministically (large β) or stochastically (small β) i's decision varies with the difference in utility between compliance and deviation. We select a value ($\beta = 10$) that is sufficiently large to make i's choice a reliable function of this utility difference, yet not so large as to make this decision completely deterministic. If $U(D)$ were equal to 0 and $U(C)$ equal to .5, for example, a slope of 10 would make the probability of deviating equal .007, meaning that fewer than 1 in 100 iterations of the choice function would produce deviation. To illustrate these choice dynamics, Figure 1 graphs the probability of deviation at selected values for A and B as a function of the proportion of deviators in an agent's neighborhood and the agent's expectation of sanctions (f_i). Deviation becomes attractive when
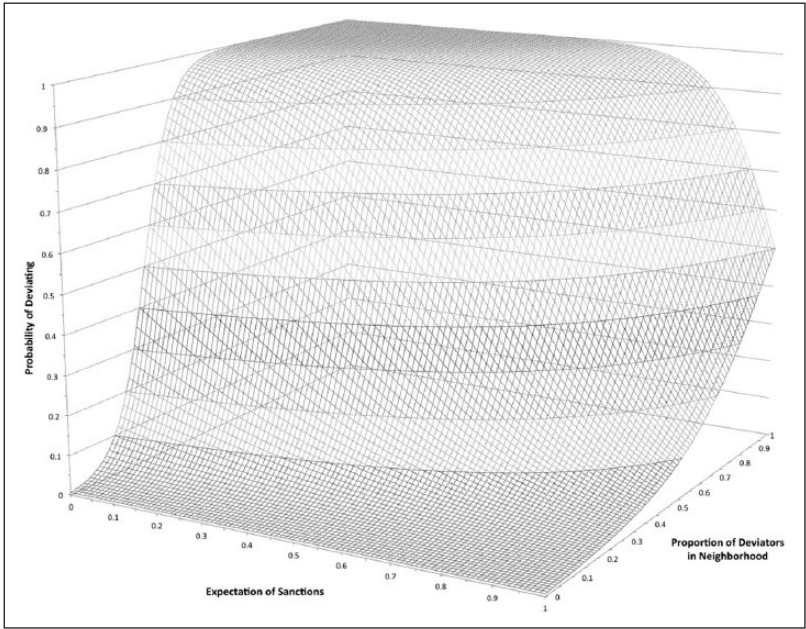
Figure 1. Probability of individual deviation as a function of local conditions.
Based on equation (4) with $A = .5$; $B = 1.5$; $\theta = .5$; and $\beta = 10$.

agents observe local conditions characterized simultaneously by frequent deviation and infrequent sanctioning. When sanctions are few and far between, deviation is attractive with even a relatively small proportion of deviators in one's neighborhood.

In our model, the state plays the role of enforcer or accommodator by applying or withholding sanctions. Specifically, the state balances its vested interest in maintaining the dominant institutional framework against the costs of sanctioning deviators. The probability of sanctioning a deviating agent i is determined by the cumulative logistic function

$$\Pr\left(S_i = 1 \mid D_i = 1\right) = \frac{1}{1 + e^{-\lambda\left[\frac{A}{B} - \frac{\sum_{i=1}^{N} D_i}{N}\right]}} \tag{5}$$

where λ is a slope parameter and N is the total number of agents in the population. The fraction A/B in the denominator gives the state's vested interest in defending a dominant norm against deviators, which is a function of the relative utility of compliance and deviation.[5] The state's propensity to

sanction deviators increases with the relative utility of compliance and decreases with the proportion of deviators in the population, since the actual application of sanctions involves policing costs that may become prohibitive when deviation is widespread.[6]

Clearly, the application or withholding of sanctions is only one way in which political actors affect institutional change. Legal and policy changes may for instance bestow *de jure* legitimacy to innovations that had already found *de facto* acceptance through widespread decoupling. While important to individual narratives of institutional change, the varying trajectories of such policy shifts make them less amenable to stylized formal models. In endogenous institutional change, these formal institutional changes *follow* from "bottom-up" emergence and diffusion processes. Therefore, we focus on modeling endogenous dynamics of change while leaving the accommodative rules crafted by political actors to discussion of particular institutional contexts.

The dynamics of the model are studied using cellular automata (Von Neumann, 1966). The 1000 agents are arrayed on a 25×40 wrap-around lattice with each agent occupying a single cell.[7] Agents influence and are influenced by the eight neighbors on surrounding cells. While highly stylized, this "Moore neighborhood" spatial arrangement has proven analytically useful for studying a variety of social dynamics ranging from residential segregation (Schelling, 1971) to the emergence of novelty (Padgett and Powell, 2012; Nee and Opper, 2012). By incorporating transitive ties (every pair of neighbors shares exactly two other common neighbors), the Moore lattice also has greater realism than the von Neumann lattice, which removes all transitivity by excluding ties to diagonally situated neighbors.[8] The model proceeds through the asynchronous updating of individual agents. In each discrete iteration *t*, a single agent *i* is chosen at random from the population (with replacement) and makes the binary choice between compliance and deviation. If the agent deviates, then the state responds by applying or withholding sanctions. To analyze this process, we track the evolution of rates of deviation in the population at large and examine the micro-dynamics explaining particular population-level outcomes.

Before proceeding, it is instructive to consider the alternative static assumption that individual deviation is only possible when $U(D)$ is strictly greater than $U(C)$. If this were the case, then we could agree with analytical game theorists in conceiving of institutions as Nash equilibria and in viewing the endogenous change of those institutions as a virtual impossibility. Yet we know empirically that even robust institutional arrangements have defectors, whether drivers who speed through red lights, petty deviants who ignore otherwise uncontroversial laws, or academics who neglect well-accepted norms of collegiality. In other words, the stochasticity (however

slight) in our model captures the essential truth that deviance and defection always lie just beneath the surface of dominant institutional arrangements.

For simplicity, we assume that $A = .5$ (since A and B are only meaningful relative to one another, .5 is an arbitrary value around which we can vary B). We condition the steepness of our two logistic functions such that deviation and sanctioning are reliably but not deterministically governed by assessments of cost and benefit ($\beta = 10$; $\lambda = 10$).[9] Finally, we assume that the agent's expectation of sanctions is a weighted average of its own recent experience and that of its neighbors ($\theta = .5$). In line with previous work on adaptive learning, this implies that personal experience weighs more heavily on agents than the vicarious experience of a single neighbor (e.g. Strang and Macy, 2001).

Model dynamics

Endogenous waves of deviation can occur when agents are free to pursue a risky but worthwhile innovation that goes against institutionalized rules. Crucially, this innovation must feature a utility gain relative to the compliant status quo ($B > A$). The utility gain provides a systemic incentive to deviate, but leaves individual agents' ability to reach this "attractor basin" uncertain. The specter of sanctions and the need for others to deviate in order to realize the full gains can inhibit individual agents from taking the risk of being early movers. Instead, the agents can remain trapped in a suboptimal state.

Yet, when agents are embedded within neighborhoods, it becomes possible for deviation to emerge in local clusters and spread rapidly across the entire population. Figure 2 demonstrates this result visually for a typical run of the model in which deviation has a relatively large 4-to-1 net utility over that of compliance ($A = .5$; $B = 2$). In the first stage of the model dynamics, deviation is rare and scattered. In the second stage, a few "anchor" neighborhoods display high rates of deviation compared to others. The third stage sees these anchors grow in size as deviation spreads to surrounding neighborhoods. This self-reinforcing process reaches its zenith in the final stage, where deviation becomes the norm rather than the aberration.

An innovation's individual utility must be relatively large in order for the innovation to successfully spread. Figure 3 illustrates this by showing the spread of deviation over time for typical replications at differing values of B.[10] Given a relatively small utility increase ($A = .5$ and $B = 1.5$), deviation remains rare and scattered; the local tipping points that "anchor" emergence simply never emerge. Given a very large utility gain ($A = .5$ and $B = 2.5$), local tipping points are quickly reached and emergence occurs rapidly. At a
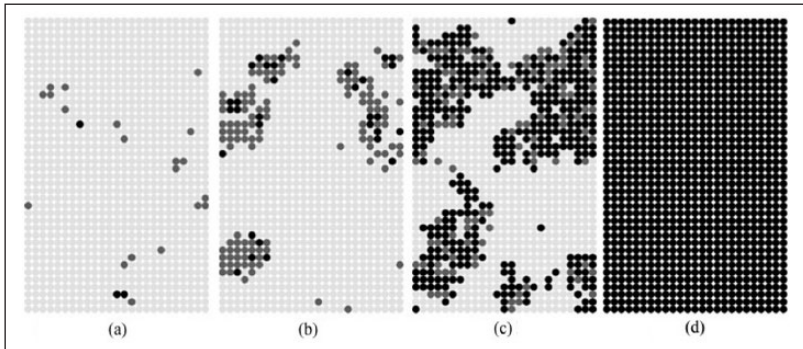
Figure 2. Spread of deviation across a population of agents: (a) scattered deviation, (b) cluster formation, (c) broader diffusion, and (d) institutional decoupling.
$A = .5$; $B = 2$; $\theta = .5$; $\beta = 10$; and $\lambda = 10$. Results are shown from a typical run of the model. Agents are colored according to the current status, with compliers in light gray, sanctioned deviators in dark gray, and unsanctioned deviators in black.
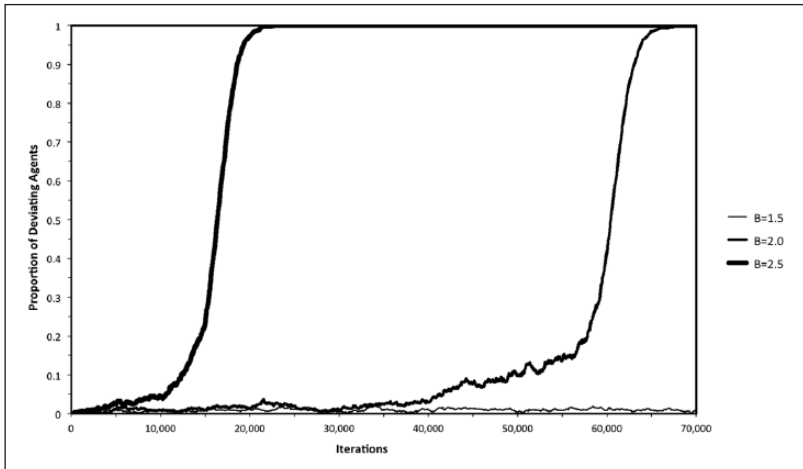
Figure 3. Spread of deviation over time for typical replications.
$A = .5$; $\theta = .5$; $\beta = 10$; and $\lambda = 10$. Results are shown for representative replications under each condition.

moderate utility gain ($A = .5$ and $B = 2$), the process undergoes many false starts. Small bastions of deviation emerge locally but are kept in check by repeated sanctions. This "whack-a-mole" dynamic persists until a local critical mass of deviators is finally reached in a single neighborhood,
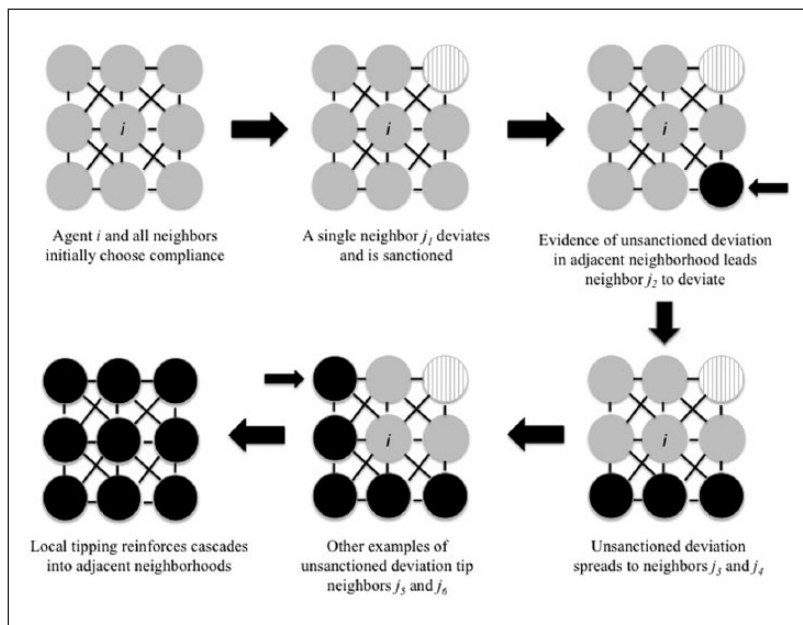
Figure 4. Reaching local tipping points.

generating a sufficiently strong anchor for deviation to tip into adjacent neighborhoods. Past this tipping point, state accommodation permits the transition from local to global emergence to appear with remarkable rapidity. If $A=.5$ and $B=2$, this accommodative tipping point is reached when 25% of the agents deviate.[11] Able to capture superior reward without the former likelihood of sanctions, previously cautious agents are quick to join the bandwagon.[12]

Figure 4 clarifies how these tipping point dynamics play out within particular clusters. The initial state of universal compliance in agent i's neighborhood is broken by a single neighbor j_1 who deviates and suffers sanctions. While this example discourages nearby agents from repeating j_1's mistake, it is soon met with counterexamples of unsanctioned deviation in adjacent neighborhoods. Even as the example of j_1's failure looms, cases of deviation without penalty can continue to mount in the local neighborhood. As agents update their calculus of costs and benefits, the number of unsanctioned deviators makes it clear that j_1's unfortunate example was an exception to the general rule. Thus, even previously cautious agents eventually follow their neighbors, reinforcing a ripple effect that spreads to other adjacent neighborhoods. When sanctioning regimes are especially persistent, of
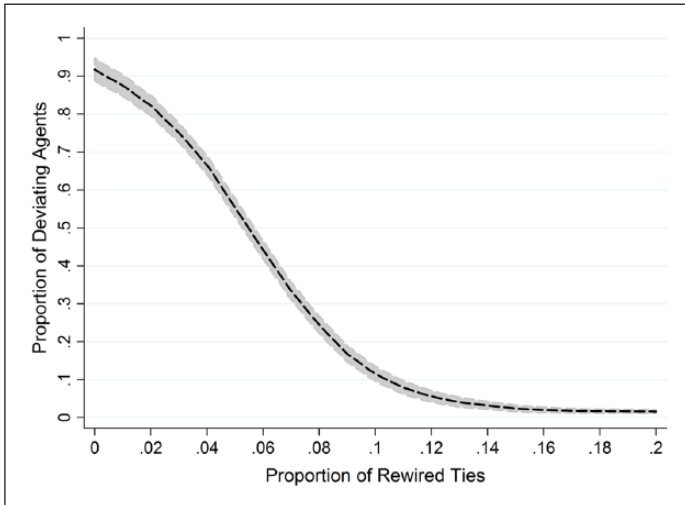
Figure 5. Rates of deviation after 500,000 iterations as a function of local versus random ties.
$A = .5$; $B = 2$; $\theta = .5$; $\beta = 10$; and $\lambda = 10$. Average outcomes based on 100 independent replications per condition are plotted using local polynomial smoothing with 95% confidence intervals.

course, examples of deviators being punished will dominate, and local tipping points may never be reached.

We further examined the effects of perturbations to local neighborhood structure in the form of network "rewiring" (Watts and Strogatz, 1998). With probability p, neighborhood ties are randomly rewired such that agents previously tied only to the eight alters on surrounding cells may now instead be tied to agents in distant regions of the lattice space. When $p = 0$, the network structure is unchanged from our baseline Moore neighborhood setup. When $p = 1$, all of the original local ties vanish, producing a random network in which each agent has an equal probability of being tied to any other agent in the population. Figure 5 shows that, by disrupting the clustered neighborhood structure, rewired long-distance ties greatly inhibit emergence. With small amounts of rewiring, collective outcomes become much more variable across replications under the same conditions—in other words, conditions that would ensure emergence with fully clustered neighborhoods become increasingly susceptible to failure as more local ties are scrapped in favor of long-distance ones.

To understand this effect, recall again the local tipping point dynamics explored in Figure 4. Deviation that emerges near an agent i in the locally

clustered lattice has several distinct ways of reaching and influencing that agent. In addition to direct flows of influence between *i* and any neighbor *j*, *i* can also indirectly influence *j* through two paths of length 2 and many more paths of length 3. When local ties are replaced by long-distance ones, the strength of such indirect influences evaporates as nearby agents come to interact with fewer mutual neighbors. From this dynamic, we suggest that—like recruitment into high-risk movement activism, the spread of health behaviors, and other "complex contagions"—the potential for sanctions from institutional decoupling creates a situation in which agents generally require reinforcement from several neighbors before they are willing to take the leap themselves (Centola and Macy, 2007). Such multiple reinforcements are in turn more easily found in clustered neighborhood structures.[13]

The simulation model thus shows that cascades of institutional decoupling emerge under relatively straightforward conditions: the occasion of an institutional innovation with high utility and positive network externalities met with accommodation by state authorities.[14] Distilled to just a few essential ingredients for understanding individual behavior, the model suggests a formal framework for analyzing dynamics of both institutional change and stability. Analysis of particular cases holds the potential to enrich this minimal formal understanding with richer contextual information.

Endogenous change in institutional context: case studies

We use case studies to illustrate individual and network-level mechanisms of endogenous dynamics of institutional change. We use a case study method not for the purpose of confirmation; instead, the aim is to provide a brief empirical sketch of endogenous dynamics in institutional change validated in our agent-based simulation and not adequately explained by top-down accounts. In each case, the formal institutional changes that legitimized the emergent economic institution were *ex post* reactions rather than initial drivers of the innovation process.

Our first case studies examine the rise of private manufacturing firms—planting the seeds for capitalism—in the Yangzi delta region of China since 1978; specifically, in two municipalities, Wenzhou and Shanghai. The following study examines the emergence of gay bars in San Francisco during the 1960s and 1970s, which laid the groundwork for the "gay economy" that up to the present day remains closely identified with the city. Table 1 provides a comparative overview, summarizing key elements and showing the core homology between these contextually diverse examples. The contrasting institutional environments and subjects contribute toward

Table 1. Comparing the two cases.

	Private industrial firms	Gay bars
Institutional context	Yangzi delta region of China	San Francisco
Institutional innovation	Illegitimate organizational form	Illegitimate organizational form
Utility gain	Economic profit	Economic profit
Social context	Multiplex business connections in industrial clusters	Close-knit group of bar owners with shared neighborhood location; co-membership in Tavern Guild
Network externalities	Information-sharing; various forms of mutual help (see Figure 6)	Information-sharing
State reaction	Resisted deviation strongly in some provinces (i.e. Shanghai), less so in others (i.e. Wenzhou)	Initial resistance that declined after 1965; lax enforcement of laws on the books
Benefits beyond in-group	Tax revenue, employment creation, and regional economic growth	Urban renewal

assessing the generality of mechanisms validated by our agent-based model and simulation.

Rise of private manufacturing in the Yangzi delta region since 1978

Our analytical focus is regional, rather than national, given the detailed spatial information on firm locations needed to further explore the key dimensions of our argument empirically. For the purpose of comparison, we examine two municipalities in the Yangzi delta region that show pronounced variation in the timing of private sector reforms prior to the country's formal promulgation of its first national Property Rights Law in 2007. We chose the city of Wenzhou as an early mover and the city of Shanghai as a late sponsor of private firm development in the region. The two cities are only about 220 miles apart from each other in the Yangzi delta region of China. Both were treaty ports in the 19th century, and they share a long tradition as important centers of artisanship and manufacturing. The litmus test we attempt here is to see whether the mechanisms suggested in our theory explain at the same time the rapid occurrence of bottom-up emergence of private firms in Wenzhou (a municipality which had little reason to employ

sanctions against deviators) and the delayed shift to private enterprise in Shanghai (a municipality with strong vested interest in maintaining a largely state-dominated economy). In this sense, both cities were selected to document the diversity of transition pathways associated with the locally unique interplay between different expectations of net utility, network externalities, and local state sanctions in case of deviating behavior.

The municipality of Wenzhou in southeastern Zhejiang Province offered nearly ideal conditions for entrepreneurs to decouple from established and legally still-favored forms of state-owned production and household farming. There on the periphery of the Yangzi delta region, the *net utility* in start-up private manufacturing was not only high, but came with low opportunity costs. At the start of economic reform in 1978, Wenzhou's large population of rural households barely eked out subsistence-level livelihoods in agriculture. The average per capita income was CNY55 (a mere third of the national average). With only 294 small state-owned companies in the municipality in 1978, and a total population of 5.6 million, there were very limited opportunities for off-farm employment in the state-owned sector. An underground economy of small household firms had flourished in the Wenzhou region (Parris, 1993; Tsai, 2002). After the start of reform, many of these firms quickly evolved into sizeable private enterprises as entrepreneurs seized on opportunities for individual utility through manufacturing in decentralized markets.

At the outset of the reform era, private firms in Wenzhou followed a pattern of local clustering. With only 4% of Wenzhou municipality classified as an urban area, and only 25% of the population registered as urban residents (Liu, 1992), the city offered ideal conditions for industrial growth in the rural counties outside the city center. Significantly, private manufacturing firms in Wenzhou were spatially concentrated in counties where there were only small, scattered populations of local government- and state-owned enterprises, and where administrators had no financial incentive to sanction the rise of new (even formally illegal) forms of manufacturing.[15] This pattern of cluster location enabled entrepreneurs to reap substantive benefits from inter-firm cooperation and coordination, which facilitated and accelerated the continuous entry of new start-up private manufacturing firms. Spatial concentration in the entrepreneurial counties thus provided conditions that favored the unfettered growth of private manufacturing firms.

In close-knit rural townships and county towns, spatial concentration of manufacturing firms enabled coordination through interacting individuals in entrepreneurial networks embedded in preexisting social structures of neighbors. We can conjecture with some confidence that the spatial concentration of private manufacturing enabled the development of *positive network externalities* (also see Nee and Opper, 2012; Owen-Smith and

Powell, 2004; Padgett and Powell, 2012; Saxenian, 1994). Established entrepreneurs often provided various forms of support, including business advice, for other start-up entrepreneurs. Provision of mutual help did not stop at the founding stage, but often matured and deepened at later stages of the business development. With an expanding network of like-minded actors operating under similar institutional constraints, inter-firm and inter-personal cooperation within the business community is a common form of self-help that does not require the development of formal business associations or semi-formal business lobbies. Standard transactions include the mutual provision of short-term loans, the joint organization of marketing strategies or supply channels, the joint development of R&D activities (including product and process development), exchange of information on new market trends and also newly launched government policies and regulations, and finally the mutual recommendation and introduction of new customers and sales contracts (Nee and Opper, 2012). Figure 6 shows a stylized depiction of the multiplex network relations (going beyond purchase and sales) an average entrepreneur would develop with his five most important business contacts.

Through a pattern of local imitation and mimicking of successful companies, entrepreneurial activities in a cluster location cumulatively powered the emergence of highly specialized production markets. In these industrial districts, new market entrants often occupied positions in the niche by introducing essentially the same products with minor modifications. New start-up firms could gain instant recognition through the collective identity of the cluster as a preeminent center of a distinct product line. The first imitators of seed firms were often family members of the pioneering entrepreneur or key technical staff persons who started their own firm after having acquired crucial expertise on-the-job (Nee and Opper, 2012). As time passed, expected *positive network externalities* in the local community lowered the perceived entry barriers and gradually led to an acceleration of the niche-specific co-location process. It is notable that these *positive network externalities* within the newly emerging organizational institutional domain are distinct from industrial agglomeration effects, as private firms kept their downstream and upstream exchange with local suppliers and customers of traditional ownership forms such as the established state-owned and collective-owned firms to a minimum (Nee and Opper, 2012).

Embedded in industrial clusters were overlapping multiplex networks connecting private manufacturers of the same novel institutional form with upstream and downstream market interfaces. Entrepreneurs benefited from access to a network of private suppliers providing the mix of technical resources and material inputs needed for flexible and adaptive production. Network externalities gained from cluster location not only
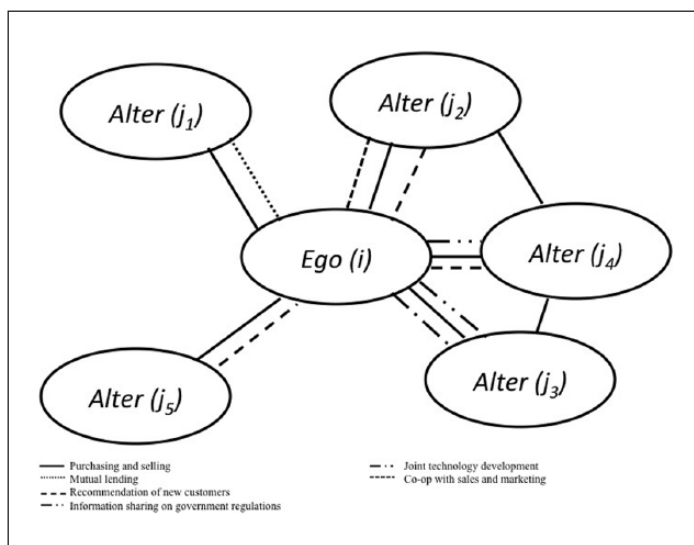
Figure 6. Stylized depiction of multiplex inter-firm relations in the Yangzi delta region.
Source: Yangzi Survey of Private Entrepreneurs 2009 (Nee and Opper, 2012).

aided survival of firms in the production market but promoted the emergence and spread of industry-specific norms. The spatial proximity in cluster locations provided fertile grounds for the face-to-face interactions required to enforce newly emergent business norms. Personalized exchange, mutual dependence in business relations, and community-backed sanctions provided the social glue that binds principals and agents to contracts, both implicit and formal.

The spread of private manufacturing in Wenzhou was facilitated by early *state accommodation* from a local government that lacked both the administrative means and the financial incentives to block the rise of capitalist forms of production. Constrained by its weak revenue base, Wenzhou's municipal government could barely maintain its basic administrative functions (Zhang, 2007) and lacked the capacity to enforce existing rules to stem the rise of private manufacturing firms. To the contrary, with per capita income far below the provincial average, local policymakers were quick to accommodate private entrepreneurial activities in the city's thriving underground economy well ahead of national legislation efforts (Parris, 1993). Early accommodations included municipal support to extend free market places, a simplified taxation system, and a temporary system of local firm registration.

In Shanghai, by contrast, potential deviators faced a different choice set. That municipality was an established center of heavy industrial production, with more than 3372 medium and large-scale state-owned enterprises operating in 1978, and an average income of CNY672 for staff and workers (more than 12 times the per capita income of Wenzhou). There, state employment remained the preferred career path well into the late 1990s (*Shanghai Statistical Yearbook*). Consistent with our argument, deviating behavior in Shanghai was rare compared to Wenzhou. Decoupling from the socialist mode of production offered relative utility gains only for the small group of people operating outside of China's state-guided labor allocation system. Thus, private sector employment remained a stigmatized occupational niche, even as entrepreneurship in Wenzhou gained social acceptance and legitimacy as a national symbol of economic success in the era of reform (Parris, 1993).

Cluster formation faced critical limitations in Shanghai due to restrictive land-use rights in an already highly industrialized metropolitan region. As a result, private firm concentration was more widely scattered over the rural suburban areas of the municipality, with high concentrations in townships in the northwest (close to the border of Jiangsu province) and the southeast. Importantly, the pervasive dominance and spread of public enterprises over the entire municipality impeded chances for private entrepreneurs to form a critical mass.

Given the strong presence of state-owned corporations and a constant inflow of foreign invested companies, Shanghai municipality enjoyed a strong revenue base. Thus, it was well positioned to retain its regulatory policies aimed at checking the growth of private manufacturing (Guthrie, 1999). Municipal leaders' strategy was to increase the size of the state-run economy in order to generate expanding tax revenue from state-owned enterprises. Between 1978 and 1992, the number of medium and large state-owned enterprises increased by 30%, which provided an abundance of new job opportunities (*Shanghai Statistical Yearbook*, various years). Well into the second decade of national economic reforms, local industrial policies in Shanghai continued to favor state-owned and foreign firms and openly discriminated against private companies. Specific investment opportunities were formally denied, and there were ad hoc interventions to block private enterprise.

Table 2 summarily compares the Wenzhou and Shanghai cases, as regards the mechanisms specified by our model. The intra-regional differences in these conditions match the comparative timing of the emergence and diffusion of private manufacturing in both municipalities, as Figure 7 shows. In Wenzhou, the population of private firms outnumbered the population of state-owned enterprises as soon as company registration opened in 1988 (although the right to register a firm did not involve legally protected

Table 2. Comparing private firm development in Wenzhou and Shanghai.

	Wenzhou	Shanghai
Institutional innovation	Illegitimate organizational form	Illegitimate organizational form
Utility gain	High economic advantage of decoupling from socialist production, given limited employment opportunities in the formal sector	A strong urban state enterprise economy continues to offer utility gains; limited incentives to decouple from traditional socialist employment system
Network externalities	Localized clustering and co-location facilitates rise of multiplex business networks; development of pronounced self-help and cooperative norms reinforces local diffusion and mimicking processes	Political marginalization and spatial constraints impede local firm clustering, which in turn limits the development of positive externalities
State reaction	Rapid accommodation due to limited fiscal resources and limited alternative employment channels	Strong resistance and ongoing discrimination through ad hoc intervention and regulatory barriers
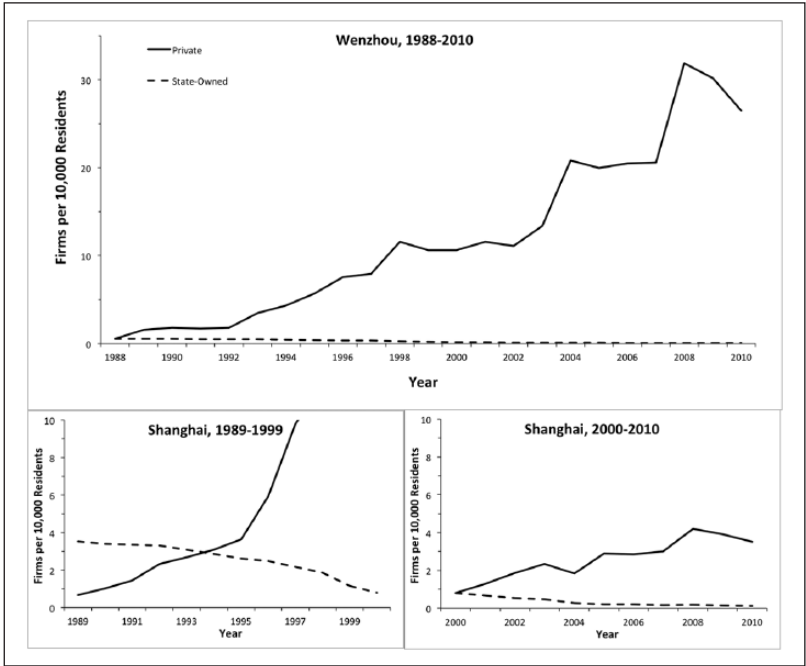
Figure 7. Private versus state-owned firms in Wenzhou and Shanghai, 1978–2010.
Source: Wenzhou City Statistical Yearbook and Shanghai Statistical Yearbook, various volumes. Accessed through China Data Center, Michigan University (http://chinadatacenter.org).

property rights or a formal legal foundation). The rapidity of the increase in legally registered private companies reflects the fact that private firms had already emerged in a bottom-up movement out from the shadow economy, with many firms exceeding the legally specified maximum of seven salaried workers. In Shanghai, by contrast, conditions for endogenous institutional change were not yet in place.

A growing state-run industrial and commercial economy provided career opportunities for legal residents of the municipality, including those residing in rural suburban towns and villages—opportunities that were attractive enough to limit deviating behavior. Moreover, the local government had the fiscal and administrative capacity to check the growth of private manufacturing in its jurisdiction. Not surprisingly, therefore, the development of the private enterprise economy in Shanghai was held back by at least a decade, in comparison with Wenzhou, and lagged behind the sequence of legal accommodation to private enterprise by the central government. In Wenzhou, private enterprise development had preceded the state's legal reform.[16]

So far our narrative has demonstrated that the key scope conditions in the development of private production in the two municipalities vary in line with our predictions. What our narrative is not able to pinpoint, however, is whether co-location of private firm clusters, on one hand, and, on the other, vested state interests—as signaled by high concentrations of state-owned firms—have in fact been significantly correlated with greater or lesser development of private enterprises in these municipalities. To examine these mechanics more closely, we zoom in to get a more detailed view of the regional development patterns. Direct support of our narrative would require network data and instances of detailed documentation of state intervention over time; data which are not available. We therefore employ an indirect strategy and focus on the impact of co-location patterns over time, expecting that social interactions are to a large extent governed by geographic propinquity (Festinger et al., 1950; Liu et al., 2010; Whittington et al., 2009). The underlying rationale is simple: if positive externalities among neighbors of early deviators are important, county-level co-location of private companies should drive the subsequent development of private production. Analogously, if vested state interests in maintaining the existing order limit institutional change and motivate sanctions and discrimination against local private production, then the presence of state-owned firms should have a moderating effect on the dynamics of bottom-up deviation.[17] Finally, to rule out that we confound co-location (and likely network-) effects of like-minded deviators (private firms) with standard industrial agglomeration effects, we also include a measure of total firm counts. Note also, although our measure of private firm

co-location shares some resemblance with density dependence arguments of the population ecology school (Carroll and Hannan, 2000; Hannan and Freeman, 1989), the underlying concepts differ. In our case, novelty is based on innovative institutional arrangements embedded in new organizational forms; by contrast, the population ecology school examines the life-cycle (the rise and maturity) of distinct industries (such as newspaper production, banking, and wine-making).

City-level data on the spatial distribution of firms is not readily available. To construct proximate location patterns over time, we rely on micro-level data from the "CSMAR Non-listed Firm"-database compiled for the years between 1998 and 2009 (GTA Data, n.d.). Our focus is on traditional state-owned companies (representing the old order and state vested interests), private limited liability companies (the most common type of private firm registration), and total firm counts.[18]

To this database we added address information. We then sorted these addresses (based on township, village, and street information) into the corresponding 17 counties of Shanghai, and 11 counties of Wenzhou. In this manner, we coded address information for a total of 46,017 firm-year observations in Wenzhou, and 151,736 firm-year observations in Shanghai.[19] In a final step, we calculated the annual aggregate numbers of state-owned and private companies by county location and scaled these by the corresponding county mean to abstract from gross effects over time.[20]

Table 3 summarizes our findings for the municipalities of Wenzhou and Shanghai separately, for both the full sample ("all years") and for the years up to the constitutional amendment in 2004. Consistent with our causal narrative, private firm development in Wenzhou was heavily driven by co-location patterns of private companies. Neither the concentration of state-owned firms nor the concentration and spread of the total firm population in prior years drive the emergence of a private firm population. This is true both for the full sample period (Model 1) and for the years preceding constitutional equality of all ownership types (Model 2). For both models, Ramsey's regression specification error tests accept the null of no model misspecifications. Variance Inflation Factor (VIF)-tests suggest no significant sign of multicollinearity (with mean VIF < 3.5). In Shanghai, by contrast, private firm development was significantly and strongly limited by the presence of local state-owned firms prior to the constitutional amendment (see Model 4).[21]

Finally, it is worth noting that co-location of the general firm population at large does not foster private firm development (M1–M4). This result offers some suggestive evidence for the positive network externalities generated by like-minded (deviating) actors belonging to the same novel organizational-type operating based on shared institutional arrangements. If general agglomeration effects had led to the rise of private firms, we should

Table 3. Regression analyses for number of private companies by county, Wenzhou and Shanghai (1998–2009).

	Wenzhou		Shanghai	
	All years	≤2004	All years	≤2004
Private firms ($t-1$)	.483*** (.085)	.409*** (.093)	.151 (.247)	.197 (.158)
State owned firms ($t-1$)	.027 (.091)	−.068 (.150)	.050 (.241)	−1.463** (.516)
All firms ($t-1$)	−.053 (.237)	−.088 (.301)	.524 (.403)	.732 (.606)
County	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
_cons	.702 (.388)	1.072 (.562)	−.117 (.458)	1.717* (.825)
Prob>F	.0000	.0000	.0000	.0000
Ramsey RESET (p value)	.632	.357	.000	.000
N	121	66	187	102
Adjusted R^2	.781	.795	.888	.919

RESET: regression specification error tests.
Data: GTA Data/Database of non-listed companies in China.
*$p < 0.05$, **$p < 0.01$, and ***$p < 0.001$ (two-tailed tests); robust (heteroskedastic-consistent) standard errors in parentheses.

see a close correlation between the spatial concentration of private firms and firm concentration in general.

Our comparison of Wenzhou and Shanghai highlights the interplay between all three mechanisms. Early dynamics of endogenous institutional change can diffuse widely, if individual actors see sufficient individual utility in deviating behavior and are able to establish private manufacturing as a new organizational form in local communities. However, such bottom-up changes are not a given. In spite of political, geographic, cultural, and historical similarities within the Yangzi delta region, the institutional pathways of both municipalities have differed substantively. The key differences were the lower relative utility gains of institutional innovations and co-location patterns involving longer distances and lower spatial concentration in Shanghai. This has led to a less dynamic movement of deviators in Shanghai, one which could easily be checked by local governments continuing to favor the established institutional order.

Emergence of a gay economy in San Francisco, 1964–1978

We now turn to a historical and cultural context sharply different from the Yangzi delta region. San Francisco's political and economic institutions,

with its long history of municipal democracy and free enterprise economy stand in sharp contrast to Wenzhou and Shanghai. Here, we trace the societal trajectory of the gay bar, a form of private enterprise that—though at times controversial—has long been especially characteristic of the bayside city famous for its central role in the history of gay and lesbian communities in the United States.

By the early 1960s, San Francisco was already widely known as America's gay mecca. However, institutions governing the treatment of gays and lesbians were slow to reflect this social fact. Gay sexual activity remained illegal under the state's anti-sodomy law. Known gay bars were frequent targets for the police and licensing authorities charged with revoking liquor licenses of businesses harboring activities "contrary to public welfare and morals" (Eskridge, 2008: 104). The police campaign against gay bars in San Francisco began in earnest in the 1940s with military efforts to control the activities of off-duty servicemen. The Joint Army-Navy Disciplinary Control Board collaborated with the chief of police and other city officials to regulate "disorderly establishments," which was code for bars that served homosexuals (Boyd, 2003). Patrons of such establishments would have to contend with military police stationed outside the door and with signs that clearly demarcated the bar as a business of ill repute.[22] Opening a gay bar was a risky form of entrepreneurial activity, linked as it was to the stigmatized subculture of gay social life. Of the 21 gay and lesbian bars founded in the city's North Beach neighborhood between 1933 and 1965 (Boyd, 2003), a few—particularly the Black Cat and Finocchio's— became lasting fixtures of the gay community. But the turnover rate was high; the modal bar survived just 2 years (again based on Boyd (2003)).

What was the *utility gain* that led to the emergence and diffusion in San Francisco of this controversial institution? What drove initial deviation from mainstream drinking establishments, and from mainstream societal norms, from the law? Not all—and likely not even most—early gay bars had gay owners. Many bar owners were heterosexual and acted on economic—rather than political—interests (Boyd, 2003). Far from crusaders for sexual liberation and political change, bar owners were largely conservative actors who sought to make a profit while avoiding ugly confrontations with the police. To this end, they often tended bar personally in order to carefully watch the goings-on in their establishment, warning gay patrons against overtly sexual behavior that might attract unwanted attention.

How then do we explain early deviation and subsequent diffusion, particularly given the risk of police raids, customer arrests, and license revocation? More than most major cities, San Francisco's bar culture was relatively free of influence from organized crime. As a result, bar owners were "petty entrepreneurs," investing their own money and retaining near-total control

over the day-to-day activities of the business (Boyd, 2003). On one hand, the likelihood of police harassment meant that any gay bar opened in the early 1960s had a relatively brief life expectancy. This downside, however, was outweighed by a large *utility gain*, as any gay bar was also expected to earn far more money than a typical "straight" bar. According to one early-60s bartender, a certain (unnamed) gay bar

> brings in more money than any bar in the city. The only place that sells more beer is the Red Garter, and beer's all they sell there. On a week night there will always be at least 75 guys in there, and on a weekend it always reaches 250 capacity. (Quote in Achilles, 1967: 244)

The profitability of the gay bar was widely known. As a result, jukebox companies and beer suppliers were often more willing to provide start-up assistance for gay bars than for straight bars (Achilles, 1967). The fact that gay migrants to the city tended to be young, unattached, college-educated professionals with disposable income provided an even greater economic incentive (Castells, 1983).

While this net utility explains the initial deviation that planted the seeds for endogenous change, *positive network externalities*—magnified by spatial concentration—emerge as another likely mechanism. In the case of San Francisco, distinguishing these network externalities from agglomeration effects is more tenuous. Yet it bears noting that, as with Wenzhou, gay bar owners did not simply co-locate where other bars and restaurants were located in San Francisco. Instead, like-minded entrepreneurs of gay bars opened bars in spatial proximity to each other. Their co-location in "gay ghettos" or "gayborhoods" established a clustered network of casual and formal affiliations between bar owners, who could regularly share information on ambiguous and shifting local conditions and coordinate with one another. Achilles (1967) describes the early bar owners as a "cohesive group" united in their opposition to "illegitimate dealings with the law" (p. 233). Self-policing norms were enacted and enforced in this network of petty entrepreneurs, for a police raid on the bar down the street might scare customers away from the neighborhood, hurting all businesses in the vicinity.[23] Virtually all early bar owners were native San Franciscans who knew the city's mores and social norms well (Achilles, 1967). Tellingly, the small minority of bar owners who were not San Francisco residents (just 3 of the 37 interviewed by Achilles) were more likely to "buck" the self-policing norm. In neighborhoods with an abundance of gay bars, some took on the identity of the "leather bar," while others appealed to college students, countercultural types, or drag queens. Bartenders were treated as local celebrities and often signaled the bar's

desired clientele (Achilles, 1967). Given this tendency to specialize, competition between businesses generally did not appreciably lessen the positive externalities associated with co-location.

Additionally, business owners formed collective associations to more effectively promote their economic interests. Membership provided access to a deep reservoir of local knowledge and resources. The prime example of such resource-sharing was the Tavern Guild, created in 1962 to defend the interests of gay bar owners. The Tavern Guild held fund-raising events and collected regular dues from members. In exchange, bar owners or patrons encountered legal trouble with the police (D'Emilio, 1983). This principle was carried even further in later years with the 1975 creation of the Golden Gate Business Association (GGBA). Despite garnering criticism from the more militant leftist wing of the gay political movement for its capitalistic and supposedly elitist orientation, the GGBA was able to successfully obtain financial support and resources for gay activities in the city (Castells, 1983).[24]

The organizational linkages induced by co-membership in gay business associations reproduced and reinforced existing informal ties rooted in shared neighborhood locations.[25] The spatial distribution of GGBA members, for example, mapped very closely onto that of all gay businesses listed in published resource guides (Castells, 1983). Members of the Castro Village Association (CVA), founded by Harvey Milk, the city's first openly gay public official, were explicitly tied to the heavily gay Castro neighborhood. Given the benefits of such formal and informal ties—combined with the ability to define a specialized "niche" and to gain access to a constantly growing market of gay migrants—setting up shop in a densely populated "gayborhood" was an almost unqualified boon to potential business owners. As our model underscores, the benefits of this deviation from mainstream societal rules and norms grew with the number of one's neighbors who also deviated. Figure 8 provides a stylized graphical depiction of these network dynamics.

To gain some quantitative empirical leverage on these patterns, we coded entries for gay bars and restaurants in resource guides listing businesses that catered to gay clientele. Due to their general completeness, resource guides are a standard data source in research on gay communities in American cities (e.g. Armstrong, 2002; Castells, 1983; Negro et al., 2013). Bars did not have to pay to be listed in a resource guide. Each listing included the bar's name and address. Some guides provided additional information, such as the general atmosphere and clientele of the bar and whether the business owner wished to identify as gay or straight. We coded two sets of guides, the *International Guild Guide* (1964–1972) and the *Gayellow Pages* (1973–1978), for a total of 1108 entries.[26] Each entry was then geocoded to census tracts. Figure 9 maps San Francisco's gay bars for each year between 1964
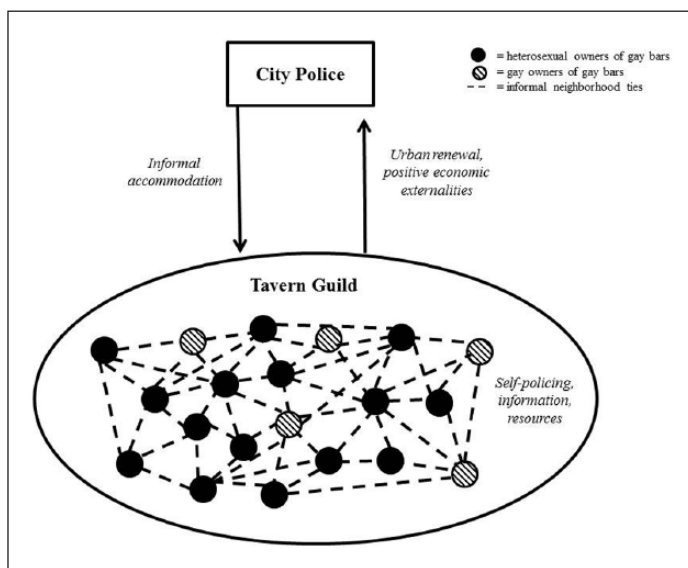
Figure 8. Stylized depiction of early deviation among San Francisco bar owners.

and 1978. The pattern clearly demonstrates the extent to which bars tended to co-locate in the same neighborhoods, as one would expect.

The changing social norms reflected by the diffusion of gay bars ran parallel to important changes in the city's demographic and socioeconomic composition. These demographic shifts, however, do not explain the observed pattern. The acceleration in both overall growth and spatial concentration of gay bars—beginning in 1970—preceded the explosion in gay migration to San Francisco, which only picked up after 1972 (Armstrong, 2002; Shilts, 1982). While the increasing trend of gay migration to the city may have contributed to the self-reinforcing growth dynamic in later years, in other words, it was not an initial cause.

Figure 10 tracks the total number of gay bars in San Francisco for each year from 1964 to 1978.[27] Through most of the 1960s, the total number of bars was relatively small but stable, falling between 20 and 40 in any given year. The largest single-year growth appears in 1970, directly following the 1969 Stonewall riot in New York City. That riot, in which customers of a popular Greenwich Village gay bar violently resisted a police raid, is often described as the catalyst for the emergence of a national gay liberation movement.[28] This post-Stonewall boom suggests an indeterminacy problem: "Was the rise of gay businesses driven by endogenous mechanisms, as we hypothesize, or by the exogenous shock of the Stonewall riot?"
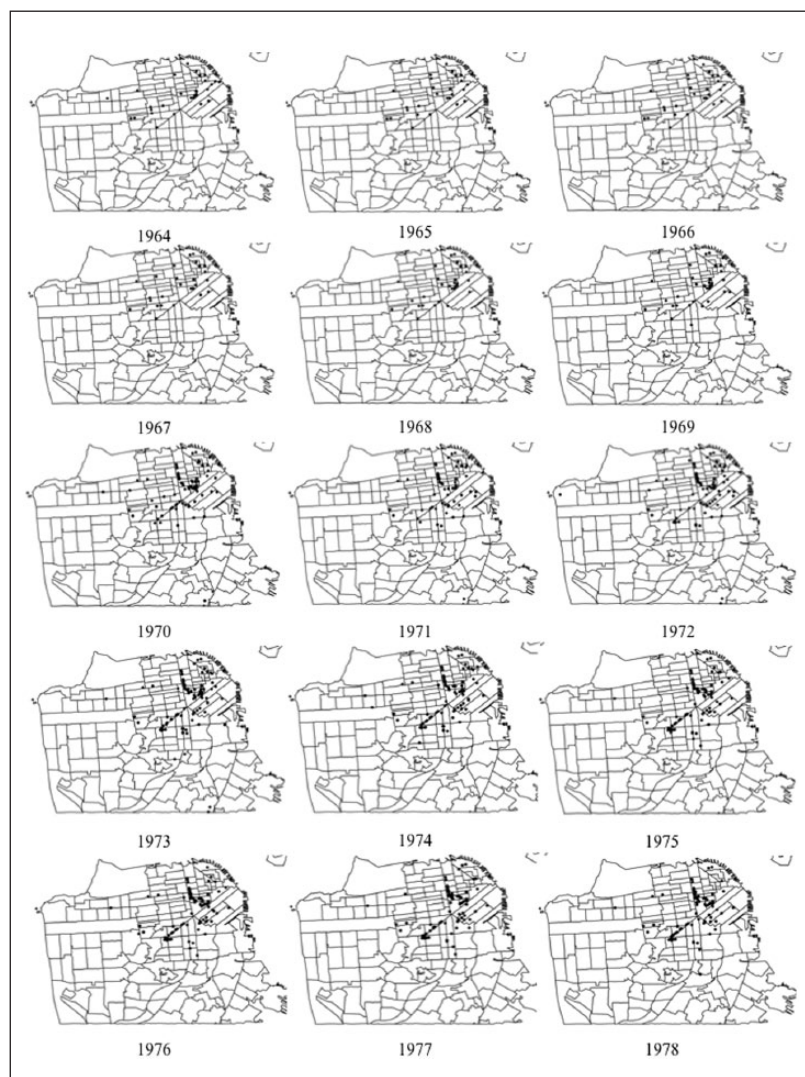
Figure 9. Spatial clustering of gay bars in San Francisco, 1964–1978. Bars are shown within 1970 census tracts.

This question is adjudicated by creating a smoothed representation of the growth curve that minimizes the visual influence of idiosyncratic observations for individual years. Processes driven by endogenous mechanisms produce S-shaped curves, while those driven by exogenous mechanisms produce
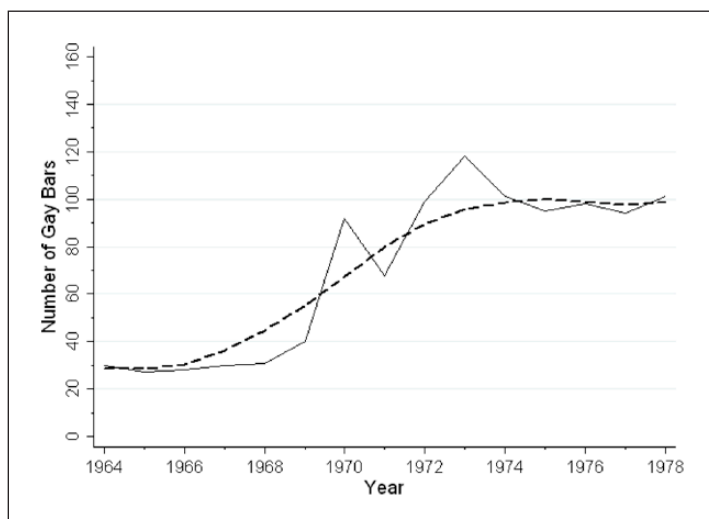
Figure 10. Number of gay bars in San Francisco, 1964–1978.
Source: International Guild Guide (1964–1972) and Gayellow Pages (1973–1978). Solid line shows number of gay bars by year; dashed line shows lowess-smoothed time trend.

negative exponential curves (Rogers, 1962; Rossman et al., 2008). The S-shaped diffusion curve shown in Figure 10 clearly belongs to the first category, suggesting a growth trajectory driven by endogenous processes. This is further reflected in the observation that the number of gay bars had already increased from 31 to 40 in the year preceding Stonewall (1968–1969), the largest single-year margin up until that point. Clearly, this need not imply that Stonewall was unimportant, but rather that this exogenous event likely came amid endogenous factors that were already at work.[29]

Nonetheless, the emergence and diffusion of gay bars could have been halted by forceful state enforcement of laws prohibiting the operation of so-called "resorts for sexual perverts" (D'Emilio, 1983: 187). We earlier suggested that informal *accommodation* of new and initially illegitimate organizational forms often precedes shifts in formal legal frameworks. In other words, de facto changes in behavioral norms come before—and in fact drive—the process of formal legitimation.

From around 1965 onward, relations between the gay community and the police in San Francisco resembled *détente* more often than open conflict. While confrontations such as Vice Squad's January 1965 raid of a ball hosted by the Council on Religion and the Homosexual stoked political tensions, they were also stark departures from the normal state of affairs. The head of the police department's Community Relations Unit

maintained open dialogue with members of the gay community, hosting town hall-style meetings at the gay community center. In such meetings, police representatives reminded residents that the authorities are obligated to enforce laws currently on the books. The overall message, however, emphasized the possibility for friendly and accommodative relations between gays and lesbians and the police. Attendees were urged to do their part by policing themselves, avoiding flagrantly illegal behaviors such as sex in public places. While entrapment by plainclothes Vice Squad officers in gay bars remained a problem, police raids and attempted license revocations became increasingly rare after 1965 (Eskridge, 2008).

Furthermore, exceptions to this quasi-*détente* were generally quite predictable, particularly in a network of business owners able to keep one another abreast of the latest trends. When a new political administration came into office, bar owners expected a temporary increase in police attention, particularly when the public had been recently primed with news stories about sex crimes (Achilles, 1967). Often, the closing of a single gay bar was sufficient to assuage public demand, after which business owners returned to their normal *détente* with the new administration. Beginning in 1970, Mayor Joseph Alioto attempted a final extensive crackdown on San Francisco's gay bars (Eskridge, 2008). The next year, newly organized gay political groups helped to elect an ally as sheriff of San Francisco County. Thereafter, police harassment of gay bars came to a virtual standstill. Informal accommodation of erstwhile-illegitimate gay bars, in other words, long preceded the legal shifts that gave business owners formal protection against police incursion. Rather than reacting to legal statutes, the city police took this accommodative stance as a practical necessity due to the heavy concentration of non-compliant business owners in the Castro and other "gayborhoods."

Discussion and conclusion

State-centered theories of institutional change have often portrayed the collective action and coordination problems faced by individual actors as being virtually insurmountable, thus necessitating that institutional change be initiated from above. However, our study helps to clarify that the calculus changes substantially when action is instead pursued by autonomous but interdependent actors embedded in overlapping webs of social relations within spatially confined communities (e.g. small-scale neighborhoods). The theory and cases laid out here undermine the widely held belief that collective action problems will ultimately impede institutional change from below. We argue that bottom-up institutional change emerges from an interplay between these factors: the utility gain associated with decoupling from institutional equilibria, proximity of individual actors

with other potential deviators over local and regional spaces, and expected sanctions the state will pursue in defense of an existing order. Even in the presence of risk of sanctioning and failure, institutional innovations can emerge locally and successfully spread beyond a small group of initial deviators if contextual features foster gainful coordination and eventual sociopolitical accommodation.

Where endogenous institutional change driven by societal action is sufficiently robust, it induces political actors to accommodate and eventually to legitimize institutional innovations from below. Simply speaking, new games are not necessarily created by those in power or a group of established players in well-bounded communities; institutional innovation and community formation may well turn out to be co-evolving processes if the contextual conditions are right. At the same time, our study highlights why the type of spontaneous bottom-up development of institutional change documented for China's Yangzi delta region is not easily replicated by other developing and emerging market economies.

The use of a simulation model allows us to examine the contextual features of institutional stability as well as parameter combinations facilitating institutional change initiated from below. Although our aim is to generate a dynamic model that combines the simplest set of behavioral assumptions required to understand contextual features that enable and motivate endogenous institutional change, the model provides sufficient room for some useful extensions and thought experiments.

For convenience, we have assumed the state to be the only actor formulating explicit sanctions against deviators. While this is consistent with the view of the state as the central arbiter of formal institutions, deviators may also face some form of sanction from other groups in civil society. These sanctions could include social disapproval, negative gossip, or outright avoidance of deviators in certain social encounters. Such additional social sanctions could warrant specific modeling of inter-group conflicts. However, since our focus is on the identification of mechanisms for successful bottom-up changes, and not on dynamics of inter-group relations, such conflicts can be conveniently interpreted as one factor influencing the shape of network externalities. With strong societal opposition, expected positive externalities could be miniscule or even negative.

We have illustrated the general contours of our theory through strikingly different examples involving distinctive institutional, historical, and cultural settings: the rise and spread of private manufacturing and economic institutions of capitalism in China's Yangzi delta region and the diffusion of gay bars in San Francisco. Both examples show periods of relative stability and rapid dynamic development, confirming the predictions made by our theory and simulation. In both contexts, change from below evolved when

individuals perceived decoupling as a more rewarding alternative than following the established order: where local concentrations and arrangements facilitated communication and coordination and where state actors were—for different reasons—slow in sanctioning deviators.

Methodologically, the combination of case study analysis with agent-based modeling is not novel. Various applications in land-use change modeling, electricity modeling, and agricultural economics have proven the utility of this hybrid approach in cases where information on individual behavior is incomplete and can only be drawn from a combination of different sources (for an overview, see Janssen and Ostrom, 2006). This is certainly a common phenomenon for studies of emergent institutional change aiming to explore the relation between repeated local interaction of autonomous but inter-connected agents and the emergence of novel institutional macro-structures. Simply speaking, a historical time-line documenting agent–agent interactions over the entire course of institutional innovation is in most cases absent, oftentimes due to the novelty of the observed (and unaccounted) behavior. Reliance on case studies and analytical narratives offers an alternative approach to identify relevant behavioral strategies that can then be transformed into plausible choice mechanisms testable in computational laboratories. Naturally, the aim of such an approach cannot be to provide definite evidence that the observed real-world phenomenon is in fact correctly explained by the suggested agent–agent interactions. The purpose is to *constructively demonstrate* whether the observed phenomenon *might* have emerged purely based on the defined micro-mechanisms and without the need for any further intervention or manipulation (Tesfatsion, 2002). Along these lines, case study grounded agent-based modeling opens an important window into deeper explorations of the likely foundations of historical processes of institutional change that would otherwise not be amenable to quantitative social science research. With growing convergence and updating of knowledge on individual behavior and choices, the potential impact on theory-building and refinement holds great promise.

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Notes

1. The existing institutional framework serves as a constraint that erodes the viability of new organizational forms viewed as illegitimate or opposition to the established order (Haveman and Rao, 1997). Support for a new organizational form can be increased through cultural-frames that appeal to state actors, professions, and other organizations as necessary, legitimate, and appropriate in the context of the established order (Clemens, 1993; DiMaggio, 1988). For example, in the rise of nonprofit consumer watchdog organizations, competition between rival organizational forms was resolved by institutional entrepreneurs framing the new form as indispensable, legitimate, and appropriate within the political establishment's ideology of consumer rights (Rao, 1998). Similarly, in the rise of *nouvelle cuisine* in France, elite chefs facilitated institutional change by constructing a cultural-frame identifying "gaps" in the established institutional logic of French cuisine such that it "cannot be an effective guide for action" (Rao et al., 2003: 805). Change within an established order can sometimes depend on strategic action by institutional entrepreneurs tailoring legitimacy accounts to appeal to core beliefs, norms, and values both at the societal and organizational levels (Creed et al., 2002; Zilber, 2002).
2. Institutional economists and political scientists have often relied on analytical game theory to model institutions (Bates et al., 1998; Calvert, 1995; Greif, 2006; Greif and Laitin, 2004). While useful in analyzing the self-enforcing dynamics of stable institutional arrangements, this approach is less suited to a theory of endogenous institutional change, where stable institutional arrangements are undermined from below. The problem emerges from the conception of institutions as Nash equilibria, which implies universal rational compliance on the part of individuals subject to institutional pressures (Calvert, 1995). As Greif (2006) posed the problem, since "[institutionalized] behavior is an equilibrium, there are no endogenous forces causing institutions to change" (p. 10). In other words, the game-theoretic approach fails to explain the empirical regularity of endogenous institutional change precisely because the impossibility of such change is built into the model assumptions.
3. We take these two options as given. For a recent theory of the content and emergence of novel behavioral norms, see Padgett and Powell (2012). While restricting the decision space to just two options is a simplification, we hold that it is a useful one: many real-world applications could similarly be reduced to binary choices (Schelling, 1973). Moreover, the main effect of extending the model to non-binary decisions would be to increase the size of the decision-making state space—thus increasing coordination complexity—rather than to fundamentally alter the general problem.

4. For simplicity, we assume externalities to be linear. Robustness checks showed that the overall model results do not hinge on this assumption, although results under particular conditions can vary with the shape of the externality. Equation (1) simply states that the utility of compliance depends on a utility that is scaled by the proportion of one's neighbors who also comply.

5. Alternatively, the state might over-value compliance relative to deviation, such as when deviating in-group behavior undermines state-sponsored ideology. In other models not shown here (but available upon request from the authors), we scale A/B with a multiplier to manipulate the state's baseline willingness to accommodate deviators. This multiplier affects the model outcomes in unsurprising ways; a larger multiplier simply means that the difference $B-A$ must become correspondingly larger in order for deviation to become widespread. In the absence of nonlinear interactions that would indicate a more fundamental shift in model dynamics, we do not introduce this multiplier in the presented results.

6. We also tested a model in which sanctions are always applied to deviators, but these sanctions decrease in strength with the number of deviators in the population. In this alternative model, diffusion occurs under similar conditions to those in the binary-sanctions model presented here. There could also be cases in which sanctions come from other agents and not just from the state, as in situations of inter-group conflict. We leave the modeling of these cases to future research.

7. Robustness checks have shown qualitatively similar outcomes—though with much slower convergence—with 10,000 agents.

8. Having said this, we have also tested the simulation model on the von Neumann lattice and found qualitatively similar results.

9. In additional tests, we found that more stochastic specifications (i.e. setting β and λ equal to 5) had two conflicting effects. In the early stages, a more stochastic model eases the initial emergence of deviation. When deviation is initially costly, there will be more deviators to the extent that the decision to comply or deviate involves greater chance. Maximal stochasticity (where the slope equals 0), after all, reduces simply to random choice. The other side of this effect, of course, is that greater stochasticity can preserve pockets of compliance even after deviation has achieved broad diffusion.

10. To check the stability of the model dynamics, we ran 100 independent replications per condition. Model outcomes differed little across separate replications with the same parameter settings. Averaged results across runs are available upon request from the authors.

11. The numerical identity of the tipping point can be found from equation (5). When $A=.5$ and $B=2.0$, the logistic function in equation (5) produces a value of .5 (even-odds of accommodation) when $D_i=1$ for 25% of agents.

12. The "noise" component in the decision function could, in theory, still cause agents to fall off the bandwagon. The reason why such tendencies do not take hold is that the relative value advantage of deviation when all other agents deviate is higher than the relative value advantage of compliance when all other agents comply (since $B>A$). This means that chance compliance in a

population of deviating agents is less likely than chance deviation in a population of compliers.

13. If the institutional innovation were more like a "simple" contagion capable of spreading through a single contact, then we would expect to find the reverse: long-range ties would facilitate rather than inhibit diffusion (Centola and Macy, 2007).

14. Based on our analysis and equation (5), one could reasonably question whether accommodation is a necessary mechanism. In the presence of a sufficiently large utility gain, could we not observe successful emergence even with a large but fixed probability of sanction? We have found that emergence is indeed possible under such conditions, but often not complete emergence—more importantly, the requisite utility gain would be so large as to be implausible in most empirical contexts. Some forms of deviance may fit these conditions; for example, undocumented immigration to developed economies.

15. Famous clusters in Wenzhou municipality include the low voltage electric equipment producers grouped together in Yueqing City, the cigarette lighter industry in Lucheng district producing 70% of the global market, the printing industry in Cangnan County, the valve and pump industry clusters in Yongjia County, Longwan district, and Ruian city, and the pen industry cluster in Longwan district.

16. For Shanghai, our illustration shows two separate panels to adjust for changing reporting standards in 1999. After 1999, the municipal statistics no longer list the total firm population but only medium and large-scale companies with annual sales of more than 5 million CNY.

17. We are aware that other reasonable explanations could be fashioned to explain the same empirical patterns. We are looking for evidence that is either consistent or inconsistent with our account, in the interest of doing the most possible with the available data.

18. By 2011, 84% of all private firms in China were formally registered as limited liability companies (*Annual Report of Non-State-Owned Economy in China No. 9*, 2012).

19. We thank Na Zou for excellent research assistance.

20. Regrettably, location data are only available from 1998 onward. However, this yields a 7-year period preceding the constitutional amendment that formally conferred equal legal status across ownership forms (in 2004). We therefore believe that the available data allow an important glimpse into structural and location dynamics of the newly emerging private economy. If we can see key dimensions of our narrative confirmed for the years between 1998 and 2004, there is no reason to believe that these played a lesser role in earlier reform years.

Our linear estimation equation is

$$Y_{pct} = \alpha + X_{pct-1}\beta_1 + X_{sct-1}\beta_2 + X_{act-1}\beta_3 + f_c + l_t + \varepsilon_{pct} \qquad (6)$$

where Y_{pct} is the number of private companies in county c in year t normalized by the municipal county mean of private companies p in the same year. Correspondingly, X_{pct-1} is the number of private companies in county c in year $t-1$ normalized by the municipal county mean of private companies in the

preceding year, X_{sct-1} is the corresponding normalized number of state-owned firms s in county c in $t-1$, and X_{act-1} is the normalized total of all firms (including collective firms, corporatized state firms, and foreign firms) in county c in $t-1$. We have also explored longer lag lengths of two and more years, but could not identify significant links. Further, f_c and l_t are county- and year-fixed effects, respectively. This is to limit the risk that patterns of co-location simply reflect advantageous business cycle effects and region-specific spatial effects not linked with patterns of inter-firm co-location. ε_{pct} is an error term.

21. While this effect is no longer visible when incorporating the entire sample period, there is still no positive effect stemming from co-location patterns (see Model 3). Both models, however, suffer from an omitted variable bias, which underscores our claim that the driving forces explaining private firm development in Shanghai did not rest on bottom-up patterns of co-location.

22. Paradoxically, these markers—rather than hurting business—initially served to increase awareness and interest among gay locals.

23. While it may seem that bar owners would need little social pressure to police their patrons, this was likely not the case; on a block where all of the gay bars prevented customers from dancing with one another or even holding hands, a single bar owner could seemingly benefit tremendously from ignoring this fairly oppressive norm.

24. Castells (1983) points out that the elitist label was probably unwarranted, as the Golden Gate Business Association (GGBA) was composed predominantly of small business owners rather than financial elites.

25. Gould's (1995) study of 19th century Parisian insurgence emphasized the salience of neighborhood location as the basis for collective action.

26. All of the archival sources are housed in the Human Sexuality Collection at Cornell University. While we also coded another guide called *Bob Damron's Address Book*, few archived editions were found for the time period under consideration, making this source less suitable for mapping trends over time. For years of overlap, we found that the *Damron* listings were very similar to those in the *International Guild Guide*. We also found close correspondence between bars listed in John Francis Hunter's 1972 travelogue *Gay Insider USA* and the inaugural 1973 *Gayellow* Pages. As a final validity check, we examined advertisements and lifestyle columns in the gay monthly *Vector* and did not observe any cases in which the mentioned businesses did not appear in our database. One reason for this congruence across different sources is that the authors tended to shamelessly copy one another. The written preambles to many guides featured sharp criticisms of perceived imitators.

27. The right-bound of 1978 corresponds both to the assassinations of Harvey Milk and new pro-gay mayor George Moscone and to the watershed defeat of the anti-gay Briggs Initiative on the 1978 California state ballot. With regard to the validity of combining data from the *International Guild Guide* and the *Gayellow Pages* in the same graph, we would note that there is no evidence of a sharp break in 1973, the year in which we switch from one guide to the other.

28. While Armstrong and Crage (2006) highlight earlier protest events in San Francisco and Los Angeles, they also note that none of them were similar in consequence to the later happenings at the Stonewall Inn.

29. Notably, however, Armstrong and Crage (2006) report that the Stonewall
    riot went largely unappreciated by mainstream gay activists in San Francisco
    (Armstrong and Crage, 2006). While other major cities quickly moved to plan
    annual "pride" parades in commemoration of Stonewall, San Francisco did not
    follow suit until 1972.

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